Method of Making a Socket on a Pipe and Apparatus for Making the Same

Specification:

The invention relates to a method of making a socket on a pipe, preferably of copper or steel or alloys of Cu, Ni and Fe, by means of a preferably multi-step or single-step expansion of the pipe end with a large jump in diameter. For effecting the expansion, the pipe end is introduced axially into an expansion tool. The invention further relates to an apparatus for making a socket of such a type.

In the manufacture of copper or steel fittings from pipes, the sockets at the pipe ends are made preferably by a stepped expansion of the pipe portion. In each required step the wall thickness is reduced during expansion of the pipe. It has been found, for example, that in case of a pipe having a nominal width > 50 mm and a wall thickness of 2.7 mm, after a two-step expansion the wall thickness is only 2.4 mm. In the last step of the expansion where the thinnest wall thickness occurs, the pipe end is, as a rule, inwardly flanged to ensure that during a subsequent joining of pipes, behind the flange a sufficient support for the sealing elements is obtained. Then later, the fitting is exposed to the greatest stress at the location of the flange and in the region of the sealing elements; this, in the worst case, may lead to leakages. Such leakages may occur if, because of the thin wall thickness, the socket is bent out at the location "A" indicated in the attached Figure 1. In the conventional manufacturing methods,

leakages as a result of an outward bending could be prevented only by initially choosing a greater wall thickness for the pipe. Thus, for the normal non-expanded portions, the pipe had to be over-dimensioned to a certain extent to ensure that the pipe withstands the required loads in the expanded portion which has the smaller wall thickness due to the expansion.

It is therefore the object of the invention to provide a method of and an apparatus for making a socket on a pipe, while an increase in the wall thickness of the utilized pipes may be dispensed with.

The object is achieved as defined in claims 1 and 5. The dependent claims 2 to 4 contain meaningful complementing method steps. The dependent claims 6 to 8 describe additional embodiments of the apparatus according to the invention.

To avoid the discussed problems encountered in the method according to the prior art, the solution according to the invention provides, particularly together with the last expansion step, or in a separate working step, for an upsetting step at the pipe end, while predetermining the inner diameter with the expansion tool. The outer diameter is limited by the upsetting device and the outer shaping shoe which surrounds the pipe end during expansion.

The method according to the invention makes possible, particularly in case of pipes made of copper or alloys of Cu, Ni and Fe, to achieve an increase of the wall thickness at locations where its resistance to forces is needed for

subsequent use. The increase of the wall thickness inherently depends from the stroke "X" shown in Figure 2.

It has been found particularly advantageous to bring the wall thickness in the critical region to the same thickness as that of the initial material of the pipe. By virtue of such a feature of the invention, the wall thickness of the initial pipe portion may be less by the amount by which the wall thickness can be increased as a result of the upsetting step. In this manner significant expenses in material may be saved. The apparatus according to the invention for making a socket on a pipe end with the described method, comprises, according to claim 5,

- an expansion tool which is axially introducible into the pipe end and which has one or more conical and cylindrical parts determining the subsequent inner diameter of the pipe end,
- one or more shaping shoes having conical and cylindrical parts determining the subsequent outer diameter of the pipe end, and
- a substantially cylindrically structured upsetting device whose smallest inner diameter corresponds, with the necessary play, to the maximum outer diameter of the expansion tool and which has a substantially radially extending annular shoulder that may be pressed axially against the end face of the pipe end during the upsetting step.

Thus, by virtue of a cooperation between the expansion tool, the shaping shoe and the upsetting device, a pipe socket of preferably multi-step enlargement may be formed. The upsetting device in essence comprises a cylindrical

tube which has an inner annular recess for receiving the expanded pipe end and which is pressed axially against the end face of the pipe end. The inner diameters of the recess and the shaping shoe are provided preferably in the region in which an increase of the wall thickness needs to be effected and are coordinated with one another in such a manner that the desired wall thickness may be obtained dependent from the intended stroke, that is, dependent from a relative displacement between the upsetting device and the shaping shoe.

The invention will be described in an exemplary manner in more detail with reference to the attached Figures 1 and 2.

Figure 1 is a sectional view of a configuration of a socket on a tube 1, made according to the invention.

Figure 2 is a sectional view of the essential parts of the apparatus according to the invention during the steps of expanding and upsetting the tube end.

The finished pipe 1 shown in Figure 1 has a wall thickness d1 which corresponds to the wall thickness of the original pipe material. Following a two-step expansion, the pipe has a first conical part 5, an adjoining first cylindrical part 7 having a wall thickness d7 which is reduced with respect to the wall thickness d1 in accordance with the extent of the expansion, a second conical part 6, an adjoining second cylindrical part 8 and an inwardly bent flange 9. The second cylindrical part 8 has a wall thickness d8 which, prior to providing the flange 9, was increased to the required extent by means of the upsetting step according to the invention. The wall thickness d8 should at least equal

the wall thickness d7. It has even been found advantageous to bring the wall thickness up to the wall thickness d1.

In Figure 2 the multi-step expansion tool 2 has already been axially pressed into the pipe end. The shape of the socket having parts 5 to 8 is formed on the inside by the parts 5' to 8' of the expansion tool 2 and is formed on the outside by parts 5'' to 8'' of the shaping shoe 3. For providing the greater wall thickness of the cylindrical part 8, the upsetting device 4, formed essentially of a cylindrical tube, is pressed with the inner shoulders 10 axially against the pipe end, while the relative displacement between the shaping shoe 3 and the upsetting device 4 may have a maximum stroke X. The upsetting device 4 has an annular recess which is intended for receiving the part 8 of the pipe end and which is formed by the cylindrical part 11 and the shoulder 10. While according to the invention it may be sufficient to perform the required enlargement of the wall thickness by the upsetting step only in the zone of the axial length of the cylindrical part 11, it may nevertheless be advantageous to simultaneously also thicken that portion of the cylindrical part 8 which is surrounded by the shaping shoe 3.

List of Reference Characters

1	pipe
2	expansion tool
3	shaping shoe
4	upsetting device
5	conical part of 1
5'	conical part of 2
5''	conical part of 3
6	conical part of 1
6'	conical part of 2
6''	conical part of 3
7	cylindrical part of 1
7'	cylindrical part of 2
7''	cylindrical part of 3
8	cylindrical part of 1
8'	cylindrical part of 2
8''	cylindrical part of 3
9	flange
10	shoulder on 4
11	cylindrical part of 4
X	stroke of 4 (maximum)
d1	wall thickness of 1
d7	wall thickness of 5
d8	wall thickness of 8